

GRAVITY DRIVEN STEERABLE VEHICLE

BACKGROUND OF THE INVENTION

This application claims the benefit of U.S. Provisional Application No. 60/159465 filed October 13, 1999, which application claims the benefit of U.S. Application No. 09/071,523, filed May 01, 1998, which application claims the benefit of U.S. Provisional Application No. 60/045490 filed May 02, 1997. - -

FIELD OF THE INVENTION

This invention most generally relates to gravity driven vehicles such as downhill racing carts. More particularly this invention relates to maneuverable, steerable gravity driven vehicles. Most particularly, the invention relates to a stable, durable gravity driven vehicle which is steerable, has at least two wheels or two skis or a combination of wheels and skis and at least one brake, is ridden in a prone, face down, face forward position and which may be ridden on varied surface terrain such as dirt, grass or snow.

DESCRIPTION OF THE PRIOR ART

Although there are various patents disclosing embodiments for devices which permit movement over a surface, the following patents known to the inventors hereof, do not in any manner suggest or teach the Gravity Driven Steerable Wheeled or ski equipped Vehicle disclosed and claimed by applicants in the instant application for patent.

U.S. Pat. No. 3,887,210 to Funke discloses a four wheeled, downhill racing cart with a steel frame and a driver's seat mounted on the frame for use on various surfaces. The rider of the cart must sit in an upright position with feet forward. The cart is steered by applying pressure with the feet to pedals attached to the front axle assembly. There is a braking mechanism which is triggered by leaning forward in the seat and engaging a braking member which is suspended from the seat frame. When the seat is leaned forward and the braking member is engaged, a plate is lowered to contact the ground surface and apply braking by frictionous contact with the ground. A rubber pad is fastened to the underside of the braking plate for braking engagement with the surface over which the cart is traveling. The cart does have handle bars, however, they are not used at all for steering control of the vehicle. The handles appear to be used for holding on and keeping the rider with the cart. The device also has carry hooks on the front handle assembly for towing of the device to the starting area. Additionally, the device can be fitted with a "roll-bar" attachment.

U.S. Pat. No. 4,098,519 to Reid, Jr. device looks most like the known "flexible flyer" type of snow sled. This wheeled sled has four wheels and may be ridden on a variety of surfaces in a sitting or prone position. The body of the device is not inclined and is composed of several, separate, wooden slats. There are slots in the body of the device for gripping when riding in a seated position. However, the prone position would be preferred in order for the user to operate the two hand brakes installed on the handle bars at the front of the device. The device is steered by way of crossed steering bars pivoted to each of the rear axle brace, front axle brace, and steering handle. The steering bars are connected diagonally to opposite positions on the front and rear axles such that the axle braces are pivoted in opposite directions as the steering handle is moved - this minimizes turning radius. Springs return the steering handle to a neutral, centered position when there is no pressure on the steering handle. The hand brakes act on the front wheels. This device does not have any sort of tow hook for pulling the sled to a starting position. There is no restraining device or harness on this, or any of the previously described sleds. There is also no "roll-bar" or any sort of plate or device to prevent injury or to keep the sled from tipping over.

U.S. Pat. No. Des. 331,031 to Janoff discloses a design for a land sled. Design patents cover only the look of the device depicted in the Figures and no real description of the device is included in a design patent. This particular land sled differs from the two previously described devices in several ways. It has two large roller type wheels, instead of four smaller wheels. It is capable of being steered by either the hands or feet and can be ridden sitting in an upright position (steering with the feet) or in a prone position (steering with the hands). The steering appears to be accomplished in a way similar to that of known "flexible flyer" type snow sleds - by pushing and / or pulling the large handle bar extending across the front of the device. There are also slots along the side of the sled, towards the back, for gripping when using the sled from a seated position. There does not appear to be any sort of incline to the main body of the sled, on which one would sit or lay prone, although it is difficult to determine much about the mechanics of a device from a design patent.

U.S. Pat. No. 5,354,081 to Huffman et. al. discloses a stunt-riding toy for use on a variety of surfaces including snow. The device may be fitted with four wheels, or skis. This vehicle has a seat and also must be operated from a sitting position, with the feet placed on plates near the front of the device. The device is quite narrow and is steered mainly by leaning in the direction it is desired to turn. The front foot plates also serve as a brake and a means to keep the vehicle from leaning too far and tipping over. If the vehicle leans too far, the plates will contact the ground surface, apply braking pressure and prevent further tipping. The device has two

handles and a rear hand cable brake which pulls a plate into contact with the wheels when the hand brake is engaged. The handles are positioned near the rear of the device, close to the seat so that the rider's arms hang down along the rider's side to grip the handles, and keep the rider in an upright position.

The invention has the particular objectives, features and advantages of: 1) a steerable gravity driven vehicle; 2) that such vehicle is ridden in a prone, face forward position; 3) that such vehicle has at least one brake; 4) that such vehicle has a plurality of wheels, most preferably four (4) wheels however the sled having three (3) wheels - the single wheel preferably located between the legs of the driver - is also disclosed and is within the scope of the disclosure of the invention; 5) that such vehicle may alternatively have a combination of skis and wheels providing for use on snow covered terrain; 6) that such vehicle may alternatively have at least one ski forward or in the front position of the vehicle and a slide pan toward the rear portion of the vehicle; 7) that such vehicle may alternatively have at least 3 skis, wherein either one ski is forward or in the front position of the vehicle or toward the rear portion of the vehicle; 8) that such vehicle as described in 1) through 4) above may be retrofitted with components in order to create the vehicle(s) described in 5), 6) and 7) above.

The patents noted herein provide considerable information regarding the developments that have taken place in this field of non-motorized vehicle technology. Clearly the instant invention provides many advantages over the prior art inventions noted above. Again it is noted that none of the prior art meets the objects of the gravity driven vehicle in a manner like that of the instant invention. None of them is as effective and as efficient as the instant Gravity Driven Steerable Vehicle for maneuvering down steep, varied surface terrain and none of them are operated from the prone face down and face forward position.

SUMMARY OF THE INVENTION

The most fundamental objects and advantages of the invention are: 1) a steerable gravity driven vehicle; 2) that such vehicle is ridden in a prone, face down, face forward position; 3) that such vehicle has at least one brake; 4) that such vehicle has at least two wheels or skis/slide pan or a combination thereof; and 6) a kit of components which are used to retrofit a wheeled vehicle to one with wheels, skis, pan or a combination of wheels, skis or pan.

It should be noted that where there are three (3) wheels on the vehicle, the third wheel may be located either at the front or the rear of the vehicle. The third wheel may be the same size as the other two wheels, or may be large or smaller. The third wheel may be independently steerable, or steerable in cooperation with the steering of the other two wheels.

The vehicle may have independent mechanical, air actuated or hydraulic actuated brakes and

may have independent hydraulic shock absorbers on some or all wheels. But the vehicle need not have shock absorbers at all, or may have shock absorption only for the front wheels, for example. The vehicle also may have an attachment for the picking up of the vehicle by, for example, a ski chair lift, and which may be a part of the driver/operator restraint system acting to keep the operator's legs from drifting off of the vehicle especially in a sharp turn maneuver. The attachment for picking up the vehicle may further serve to protect the rider should the vehicle roll over. However, this attachment is not fundamental to the invention.

A primary object of the invention is to provide a gravity driven steerable vehicle comprising a chassis and a riding surface on which a rider is oriented in a prone, face down, face forward position, at least two wheels or skis or combination thereof, means for steering the vehicle, means for causing deceleration or halting of motion of the vehicle, and means for harnessing the rider onto and into the vehicle.

Another primary object of the invention is to provide means for steering each wheel independently.

A further primary object of the invention is to provide means for absorbing shock exerted on said vehicle caused by the vehicle passing over rough terrain.

Another object of the invention is to provide means for towing the vehicle to the top of an incline, and means for assisting the rider in staying on the vehicle and protecting the rider if the vehicle were to roll over.

Yet another object of the invention is to provide such a vehicle further comprising four wheels.

Another object of the invention is to provide such a vehicle having three wheels.

A still further object is to provide a safety brake which actuates upon release of the hand grips for operation and parking safety if a rider were to fall off of the vehicle during operation of the vehicle.

A yet still further object is to provide a means for automatically causing the vehicle to hold a constant turn which actuates upon the occasion if a rider were to fall off of the vehicle during operation of the vehicle.

These and further objects of the present invention will become apparent to those skilled in the art after a study of the present disclosure of the invention and with reference to the accompanying drawings which are a part hereof, wherein like numerals refer to like parts throughout, and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 shows a top plan view of the vehicle, illustrating the body curvatures, the rider inclined riding surface/bed and the like;

Fig. 1A shows a side plan view of the vehicle, illustrating the body curvatures, the rider inclined riding surface/bed and the like;

Fig. 1B shows a front plan view of the vehicle, illustrating the body curvatures, the rider inclined riding surface/bed and the like;

Fig. 2 shows a top plan view of the vehicle, showing, in shadow the axle, steering, and wheel spindles;

Fig. 3 shows a top plan view of the three (3) wheeled embodiment of the vehicle;

Fig. 4 is a detail view of the assembly axle with an air/oil shock used in the wheel suspension;

Fig. 5 is a detail view of the assembly axle with a coil/oil shock used in the wheel suspension;

Fig. 6 is a detail view of the hydraulic rear wheel brake system;

Fig. 7 is a detail view showing the steering linkage in association with the prone steering position of the rider;

Fig. 8 is a detail view showing the right rear wheel spindle;

Fig. 9 is a detail view showing the right front wheel spindle;

Fig. 10 illustrates detail of the tow-bar assembly which also is a part of the rider restraint system;

Fig. 11 is a combined drawing of a top plan view, and side plan view and a rear plan view showing, in shadow, substantially all of the components and their relationship and which illustrates a wheeled vehicle retrofitted with skis on the front and wheels to the rear;

Fig. 12 is a combined drawing of a top plan view, and side plan view and a rear plan view showing, in shadow, substantially all of the components and their relationship and which illustrates a wheeled vehicle retrofitted with skis on the front and the rear;

Fig. 13 is a combined drawing of a top plan view, and side plan view and a rear plan view showing, in shadow, substantially all of the components and their relationship and which illustrates a wheeled vehicle with skis on the front and a slide pan to the rear which slide pan has grooves directed from front to rear which provide lateral stabilizing of the vehicle and which has a suspension system and a piston actuator which actuates braking by pressing the shovel/blade into the snow surface;

Fig. 14 is a combined and sectioned drawing of a top plan view and a rear plan view showing, in shadow, substantially all of the components and their relationship and which illustrates a braking system for a vehicle having wheels in the rear; and

Fig. 15 is a combined and sectioned drawing of a top plan view and a rear plan view showing, in shadow, substantially all of the components and their relationship and which illustrates a braking system for a vehicle having wheels in the front.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following is a description of the preferred embodiment of the invention. It is clear that there may be variations in the size and the shape of the gravity driven wheeled vehicle, in the materials used in the construction and in the orientation of the components.

A. THE WHEELED GRAVITY DRIVEN VEHICLE:

In order to most simply and clearly characterize the essential features of the invention reference is made to drawing Figs. 1, 1A, 1B, 2, 3, 6 and 10 in which the essential elements of the invention are identified by numerals (not in a circle). Figs. 4, 5, 7, 8 and 9 are details of various elements which are well known to the ordinary skilled artisan.

It is also important to note that the instant vehicle invention may have one wheel in front and one wheel in the rear. It is also possible to have three wheels with the single wheel either in the front or in the rear of the vehicle. Steering may be effected by using either the front wheel(s) or the rear wheel(s) or both. Braking combinations are likewise possible - front wheel, rear wheel or both.

With reference now to particularly Figs. 1, 1A, 1B, 2, 3, 6 and 10 there is illustrated a four wheeled gravity driven steerable wheeled vehicle 10. There is a chassis 12 having chassis front portion 12A, chassis rear portion 12B, chassis underside 12C and chassis top side 12D. A rider riding surface 14 is on chassis top side 12D and is configured to cause a rider on rider riding surface 14 to be oriented in a prone, face down, face forward position. There is provided a means for attaching, 16, a rear axle assembly 16A substantially at chassis rear portion 12B. There is also means for mounting, 18, a front axle assembly 18A substantially at chassis front portion 12A.

Provided also is a means for steering, 20, gravity driven steerable wheeled vehicle 10 or three-wheeled vehicle 40 by the rider when the rider is positioned on rider riding surface 14. There are rear wheel hub and spindle assemblies 22 integral with rear axle assembly 16A. Wheels and tires 23 are normally mounted to the wheel hub. Front wheel hub and spindle assemblies 24 are integral with front axle assembly 18A.

A braking system or means for causing deceleration and halting of motion 26 of vehicle 10 when vehicle 10 (or 40) has motion is provided. Braking system 26 may be hydraulic, mechanical or a combination of the two and braking may be of all wheels or some of the wheels.

In order to held the rider stay on vehicle 10 or 40, there is a means for harnessing, 28, the rider onto and into rider riding surface 14 when the rider is positioned on the vehicle. To provide additional comfort for the rider and to improve the stability of the vehicle while moving, there may be provided means for absorbing shock 30 exerted on each of the front wheels and tires 23 attached to each of the two front wheel hub and spindle assemblies 24 thereby damping shock caused by vehicle 10 passing over rough terrain, between front wheels and tires 23 and front axle assembly 18A. There may also be means for absorbing shock 32 exerted on each of the rear wheels and tires

23 attached to each of the two rear wheel hub and spindle assemblies 22 thereby further damping shock.

In order to get vehicle 10 or 40 up a ski slope for example, there is provided a combination rear roll bar and transport bail 34. When the rider is on the vehicle, bar 34 is in the lowered position providing the rider with a roll bar and an object against which pressure may be applied when the rider is in a sharp turn. Bar 34 is placed in a second position which permits attachment to a lift such as a ski lift.

In order to discuss some of the engineering features, reference is again made to the drawings including Figs. 4, 5, 7, 8 and 9. The drawings show simply the preferred embodiments of the vehicle which have the following preferred specifications:

Figure 1 shows a top, side, and front plan view of the vehicle, illustrating the body curvatures, the rider inclined riding surface/bed including the 11" diameter high speed pneumatic, tubeless tires in the preferred embodiment of the vehicle, which are designed for motor vehicle racing at speeds in excess of 100 mph and which provide excellent traction and a soft but firm ride.

Advanced four wheel "A" arm air spring, oil damped suspension - independent four wheel suspension with air/oil shocks or with coil/oil shocks is provided and yields a smooth, stable ride over surfaces with irregularities ranging from wash board to large bumps. However, not all four wheels need have suspension, possibly only the front wheels might have suspension. Also, the vehicle could be made in either a four-wheeled or three wheeled embodiment. In either embodiment, the suspension is not essential. Figure 3 illustrates a three (3) wheeled embodiment of the vehicle. Figure 4 shows a detail view of the assembly axle with an air/oil shock used in the wheel suspension, and Figure 5 shows a detail view of the assembly axle with a coil/oil shock used in the wheel suspension.

Independent hydraulic braking is provided from dual, rear wheel, hydraulic disk brakes, designed for motor vehicle racing at speeds to 150 mph and operated with a single hand lever. These brakes give smooth, uniform and powerful braking capability whether with a four or three-wheeled embodiment. The braking system could be modified for a three-wheeled embodiment. Figure 6 is a detail view of the hydraulic rear wheel brake system.

There is provided a combination rear roll bar and transport bail. This bar is hinged so that locked in the folded down position, it tends to confine the legs of the rider and further resists overturning of the vehicle. When this bar is in the unfolded or up position it is useful as a tow or lift bar which may be attachable to a ski lift as an example of use. However, it is possible to have an embodiment of the vehicle without this feature. Figure 10 illustrates detail of the tow-bar assembly which also is a part of the rider restraint system.

The prone (lying down) low center of gravity design provides control and good visibility. It is also possible that this low position may add to the level of safety for the rider. The extremely low center of gravity provides a relatively stable and safe ride - overturning is nearly impossible.

There is provided a safety harness which enhances control, stability and rider safety, and which is shown illustrated in Figures 2 and 3. The shoulder harness provides rider stability and contributes to rider safety by keeping the rider in place on the vehicle.

There is also an automatic brake which actuates upon release of the hand grips for operation and parking safety. This feature is not essential to the basic embodiment of the invention, however this is an important additional feature. With this safety braking mechanism, the vehicle will be stopped if the rider were to fall off of the vehicle at some point during the operation of the vehicle. Additional to the automatic brake system there may also be a means for causing the vehicle to go into a constant tight turn mode of operation if the rider loses control or if the rider fall from the vehicle while in motion.

The surface of the vehicle on which the rider lays is comprised of a closed cell body pad for rider comfort. There is an elevated chest rest and thick foam mat which provide additional rider comfort and visibility.

In the preferred embodiment, the body and chassis of the vehicle is made from light weight foam core fiberglass reinforced construction. The strong, rigid, impact resistant foam filled fiberglass body with aluminum inserts provides a single framework for attachment of all components. Fiberglass body, plated steel parts, and extensive use of aluminum provide optimum protection from the elements, and from impact damage.

The steering and braking mechanism is a ball bearing bicycle style steering and braking assembly which is positive, responsive and familiar to all to control, thus making learning to ride, and riding the vehicle easier and more comfortable. Figure 7 is a detail view showing the prone steering linkage.

There are provided precision bearings on all four axles in one embodiment. Independent rear axles provide maximum maneuverability in a four wheeled embodiment.

The vehicle may be provided with precision wheel hubs, with pre-lubricated ball bearings, which are maintenance free. In a preferred embodiment the suspension and steering spindle bearings are formed of woven TEFLON or NOMEX and are designed to withstand high impact forces and hostile environments, and provide long life with no maintenance. Figure 2 shows a top, side, and front plan view of the vehicle showing, in shadow, the axle, steering, and wheel spindles. Also, Figures 8 and 9 show a detail view showing the right rear wheel spindle and a detail view showing the right front wheel spindle.

The preferred steering post ball bearings and linkage ball rod ends provide maintenance free, smooth, zero back lash response. Each vehicle may be provided with elastomer bumper strips in the front and the rear which provide impact protection for the vehicle and rider. The preferred steering post, wheel, and front and rear axle assemblies can be removed intact should maintenance be required, thus reducing time and cost of any necessary maintenance.

In a preferred embodiment, the vehicle chassis has a ramp-shaped underbody and

detachable covers which offer protection for axles, steering linkage, and suspension from road obstacles. Each vehicle in the preferred embodiments has strong, impact resistant fiberglass fenders which protect the rider from track dirt and contact with the wheels when riding.

B. THE GRAVITY DRIVEN VEHICLE WITH SKIS OR COMBINATION OF SKIS AND WHEELS OR SLIDE PAN

While much of the following description is presented as a description of a wheeled vehicle similar to the vehicle of the present invention as described above but which has been retrofitted or specially constructed to result in the vehicle for use on snow covered terrain. It is important to note that the vehicle basically as described above but modified for use on snow may be custom made rather than created from a wheeled version by means for retrofitting the wheeled version. All of the disclosure above is applicable to the disclosure of the ski version of the vehicle except of course that portion which relates to the specifics of the braking system and some aspects of the steering systems.

1. RETRO FIT KITS/SKI VERSION

The retrofit kit is used in conjunction with the gravity driven wheeled vehicle of the present invention or other like products to make the product easily adaptable for use in snow covered conditions. The details of the systems described below apply as a retrofit package or basically describe the components and the function when applied to a gravity driven vehicle custom designed and dedicated for use only on snow. I.e., a wheeled vehicle may be retrofitted with the combination of skis or slide pans or custom designed and built in the same manner. Figs. 11 - 13 illustrate the vehicle with skis in the front and wheels to the rear, skis both front and rear, and skis in front and a slide pan with braking to the rear respectively. It should further be noted that the use of skis and slide pan or slide pans is interchangeable in that they both provide the sliding surface upon which the vehicle rides when in descent on a snow covered surface. A slide pan or ski may be used in any combination in the front in the rear or both front and rear locations of the vehicle.

Front steering system - Figs. 11 - 13

- A. The front ski retrofit is attached to the existing front a-arm (wishbone) assembly of the wheeled version with either a double or the single arm / linkage geometry by utilizing the existing fastening system. When fixed to the suspension linkage the ski has the ability to pivot from an axis perpendicular to the axle allowing the tip and heel to pivot in opposition to one another, upwards and downwards and is limited in its

pivot by a stop mechanisms mounted to either the ski or the mounting system. The width and length of the selected skis and the forward or rearward positioning of the pivot point is established in relation to the performance requirements of the terrain. The steering geometry has been designed to create a carving action when the skis are turned by the steering linkage, meaning that both ski tips rise slightly, the tails sink slightly and the inner edge of the ski opposite of the direction of the turn and the outer edge of the ski in the direction of the turn tilt slightly downwards into the snow, ice running surfaces. These edges can also be described as the ski edges on the inner radius of the turn.

Brake system - Figs. 13 - 15

- B. The independently or simultaneously actuated right and left, rear, front or rear and front, or independent rear and front combined brakes or single brake actuation unit whether one or divided mechanism is integrated in to the front ski and trailing or sliding pan or ski assemblies that are part of the vehicle/mountain sled retrofit package. The actuation of the mountain sled brake is either mechanical, hydraulic, servo-mechanical, pneumatic or a combination of these technologies. When this solution is used as a retrofit it is intended whenever and wherever possible that the existing actuation system or systems be utilized.

Rear tracking and control system - Fig. 13

- C. The rear brake system or systems is / are integrated into a under body pan covering a portion or all of the sled under body from approximately the middle of the sled length and some distance forward of the rear axle location mounting surfaces and is attached or nearly meets the sled underside and extends sufficiently across the width of the sled in the front in a fixed or in a limited manner with a hinge or slide like interface allowing the pan from the hinge point rearwards to move up and down or to slide or flatten out across the under face of the sled a distance equal to the translated stroke distance of an internally mounted shock system. The pan will be a complete cover with a downward sloping straight or radiused lead edge, running from the mounted or hinged or meeting leading edge and transitioning to a gliding surface that runs almost parallel to the underside of the body or sled frame. The rear pan or ski assemblies will be covering a single or double shock absorption mechanism able to operate independent of or together with each other and the braking mechanism that will be substantially a swing arm or linearly actuated arm or blade that will when actuated protrude out from the pan or ski below their running surfaces and into to the snow or ice surface at a positive, negative or right angle to the pan or

running surface and will be depth adjustable equal to the geometry and stroke of the actuation. This pan or ski (if chosen) as seen from behind is profiled to provide maximum lateral grip and stability when either turning or gliding. The geometries are optimized to address snow condition and terrain. The final geometries are not disclosed here.

Benefits

- D. Commercial: The winter retrofit package allows an owner of a summer mountain sled the simplified and flexible solution of utilizing at minimum the sled body with integral frame or body with separate frame and possibly many more components such as the axle, suspension, steering, braking systems of summer mountain sleds to readily adapt it for winter recreation.
- E. Technical: The retrofit steering, braking, and rear tracking and control systems provide in conjunction with the already known benefits of an extremely controlled, stable and sure snow sledding experience.
- F. The benefits are therefore commercial as well as technical.

2. ALTERNATIVE SKI VERSION

The condition of downhill ice packed or ice covered roadways, trails, paths, etc. presents a braking, steering and control challenge for both a conventional summer mountain sled and a winter mountain sled and many other sleds. The operational challenge is to provide a sled with a steering and braking solution that handles these conditions. The following embodiment of the invention and declared benefits address this challenge.

A mountain sled equipped with four wheel or three wheel independent or simultaneous braking systems will have its standard tires replaced with slick or profiled tires that have been retrofitted or produced, to order, with studs, nails, screws, etc. fixed to, inserted into or imbedded in the rolling surface of the tire and protruding from the rolling face of the tire sufficiently to provide contact and grip in the existing ice or ice packed condition on the running surface. The selection of each tire profile and cleat material, cleat geometry and cleat placement and number of cleats is dependent solely on the application surface and can be changed and optimized accordingly to best suit the exact requirements of each downhill surface.

Benefits Alternative Ski Version

This solution has the distinct benefit of providing exceptional control on most every downhill ice covered or ice packed roadway, trail, path, etc. running surface.

I. Due to the fact that only the optimized tires are replaced to provide improved friction interface between the sled and the running surface all other subsystems, steering, suspension and braking remain the same and the product can be utilized to the extent of its capability as used on many other surface.

I Double arm independent suspension (upper and lower control arm design)

The challenge of providing superior handling and control of a gravity driven mountain sled is to offer the best technology to achieve differing optimized operating results to meet the demands of the conditions and requirements of various terrains. The integration of certain solutions in a mountain sled with tires or with winter attachments such as in various presented solutions is primarily possible due to the combination of certain existing technologies, materials and compact componentry and by integrating them into various suspension geometries. Although the below solution is in various iterations already integrated into many automobiles and other means of transport, had it not been for the development of and the availability of small components from the mountain bike industry, allowed sophisticated mountain sledding to evolve from unsophisticated toys.

The solution here is to integrate into a mountain sled product, a suspension system that displays, when viewed from the side (from sled rear to front or front to rear), a suspension geometry that is trapezoidal in form (parallelogram) with all four joints forming pivots and the two sled side, upper and lower fastening points/pivots are fixed in some known manner firmly to the sled frame or uni-body or axle system or combination thereof and the spindle or the ski assembly or ski pan assembly is fixed somewhere on the fixed member connecting the outboard pivot points of the trapezoid. As part of this design and resisting loading of the trapezoidal design is an arm that extends at an angle away from one of the inboard trapezoid pivot locations and is an integral mechanical arm to which a shock absorber is attached to the end of arm and to a fixed point on the body, frame or axle system and both ends of the shock absorber can pivot. This geometry allows the upright mounting face for the spindle or ski or pan to move the spindle or ski or snow pan assembly upward and downward when the sled is pointed straight forward and when the sled itself has certain load exerted and released such that the tire, ski or pan maintains complete contact of its lower running surface with the operating surface, the running surface remains parallel with itself as it is loaded and unloaded. The longitudinal motion of the entire assembly is limited by the stroke of the shock absorber and the operating envelope of the related mechanics. This design permits minimal axial motion of the contact running surface as it is loaded and unloaded called scrubbing. This scrubbing action is considerably less than that witnessed by the solution already presented in the claim from TSI with a single arm solution.

Benefits

This solution gives the clear benefits of

- II. Maintaining constant and maximum contact of the entire running face of the tire, ski, and pan solutions with the running surface.
- III. Reduces scrubbing and non-uniform wear of the running surfaces of the tires, skis and pans.
- IV. Simplifies steering geometry compound angles allowing maximization of ski contact and carving benefits. This system is highly recommended for applications utilizing skis and sliding pan systems.

II Integrated Body & Frame solution

The body design and construction for the instant vehicle represents the latest form of taking the idea of monocoque or body integral frames and eliminating the need for conventional frames and separate bodies for use in mountain sled, sleds and sled product applications. This idea utilizes the fiberglass upper and lower body components known as or halves and sandwiches them together and imbeds inserts to add strength, to bond the halves, to stiffen the body and to take maximum advantage of the collective strength of each system. This solution accommodates and allows the fiberglass to be a connecting structure through the use of adhesives and epoxies that are part of the normal fiber-glassing process of dissimilar materials. This permits the combination of a variety of materials that would not otherwise be combined in a conventional frame / body construction. The imbedded materials then are optimized for their ability to retain fasteners, to choose material that accommodates extreme variations in temperature, adequately spread load across the fiberglass surface and eliminating extra material where it is unnecessary.

Benefits

The benefits from such a solution are;

- I. Provides singular body and frame system, simplifying assembly, inventory and repair.
- II. Makes maximum use of the strength and stiffness of each system.
- III. Allow adaptability and design modifications when new materials come available without requiring the whole design be changed.

There are additional subsystems which may be incorporated into the gravity driven vehicle of each of the embodiments described such as for example:

- Rollover protection
- Steering damping
- Accessories such as headlights, speedometer
- Adjustable steering ratios
- Prone sled body angle support system
- Complete braking system i.e., one system for the front and one for the rear which may use two (2) independent master cylinders and brake circuits.

While these additional subsystems are not being described in detail herein, it is certainly within the skill of the ordinary artisan in the field of mechanics and mechanical design to understand and implement many types of mechanisms or systems addressing the incorporation of any or all of the above subsystems into any one of the vehicles as described as the instant invention.

It is thought that the present gravity driven steerable vehicle, for use in riding or racing primarily down hill over varied terrain, and many of its attendant advantages is understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts thereof without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred or exemplary embodiment thereof.